3/PRTS

Annex C

10/507123

Amended description in response the written opinion of 15.10.2003

ACOUSTIC CONSTRUCTION ELEMENT

The present invention relates to an acoustic construction element comprising sound insulating cavities.

Numerous variants of this type of acoustic construction elements have been proposed in the art in order to provide a more or less satisfactory balance of the acoustic properties and the cost of production.
Many of these attempts are disclosed in the patent literature.

In European patent application n° EP 0 580 096, for example, there is described a sound-insulation element having a wall exhibiting perforations, and having a cavity which receives a sound-absorbing packing, which covers the mouths of the perforations.
The acoustic bricks usually consist of ceramic material.

In French patent application n° FR 2612225, there is revealed an acoustic lining element, made of burnt clay, ceramic materials, cement, wood, plaster or the like. This acoustic lining element comprises a plane rectangular face intended to be attached to a wall. The opposite face to this one comprises a network of ribs forming corrugations parallel to one of the sides.

Japanese patent application n° JP 09328833 describes a sound-absorbing block, obtained by baking fire clay, into which a pore imparting material is mixed, and fire-resisting chamotte. In the ceramic block, there are bored holes of different depth, drilled all over at right angles to the thickness direction. The ceramic block is reported to have sound absorbing performance in a frequency band having broad width.

In German patent application DE 198 23 139, there is described an acoustic element comprising sound insulating cavities having a constant shape along an axis parallel to the exposed surface of the construction element, at least part of said cavities are first cavities comprising a first portion, situated closest to the external surface of the element, having a smaller width than the maximum width of a second, internal portion of the cavity. Furthermore, in one or more of the embodiments, for instance as shown in figure 26 of DE 198 23 139, at least part of said cavities are second cavities which have a substantially constant width over their entire depth, and art partially filled with damping strips out of gummy or a synthetic material.

However, all first cavities have the same depth, and also all second cavities have the same depth. Only in all of the second cavities, the same damping strip is provided. In this way, only a limited area of sound frequencies can be absorbed by such an acoustic construction element.

German patent application DE 33 22 189, French patent publication FR 2 746 831 and US patent application US 2,281,121 describe construction elements comprising cavities with different shapes and sizes.

DE 197 41 282 discloses acoustic construction elements showing several subsequent layers of zones of different structure and/or nature, whereas part of said zones consist of ceramic foam.

In US 2,281,121, a load bearing acoustic building block is described which is formed of plastic material having all of the properties of the vitrified building block as to strength, appearance and density, and provided with sound absorbing properties, whereby the block may be used to construct the interior of walls and partitions of auditoriums by being laid in mortar or cement in the usual manner, and when so laid will absorb and diffuse audible sound waves striking said wall or partition to prevent reflection of the same to such an extent that undesirable echoes may be eliminated within the room of building formed of said blocks without the application of independent sound absorbing material. In one of the embodiments of such an acoustic building block, the cavities are filled with a quantity of particles of material, such as sawdust or expanded mica flakes, to form sound absorbing filter.

Each of the individual solutions thus proposed in the art to improve the properties of acoustic construction

elements have shown to be satisfactory to a very limited extend.

Combining those various solutions would of course appear as a further way forward but it has shown that several of the proposed solutions are mutually excluding or give rise to practical technical problems.

The purpose of this invention is to combine, in a very specific way, some of the proposed features with other added features so as to provide an acoustic construction element having optimal properties.

The invention thus provides a sound insulating construction element that can absorb a broad range of sound frequencies and that can be manufactured depending on the type or the frequency of noise pressure.

For instance, the frequency of the disturbing noise that results from a truck that drives on a highway differs from the noise that has to be absorbed when one records a song in a music studio.

This object of the invention is achieved by providing an acoustic construction element comprising sound insulating cavities having a constant shape along an axis parallel to the exposed surface of the construction element, at least part of said cavities being first cavities comprising a first portion, situated closest to the external surface of the element, having a smaller width than the maximum width of a second, internal portion of the cavity, and at least part of said cavities (3) being second cavities having a substantially constant width over their entire depth, wherein

- at least part of said first cavities and at least part of said second cavities have different depths;
- at least part of said first cavities have different internal volumes and/or different internal shapes;
- at least part of said first and/or second cavities are completely or partially filled with sound insulating material.

According to a first preferred feature of the invention, at least part of the first cavities have an angular shape.

The intention of this is to provide a volume as large as possible after the entry.

According to a further preferred feature of the invention, at least part of the first cavities have a pseudo-rectangular shape. So, there is more reflection of the sound inside the cavity.

Pseudo-rectangular means that the cavities have at least one acute angle.

In a first embodiment, at least 90 % of said first and/or second cavities are completely filled with sound insulating material.

In a second embodiment according to the invention, at least 90 % of said first and/or second cavities are partially filled with sound insulating material.

In a preferred embodiment of the invention, said first and/or second cavities are completely or partially filled with foamed mineral product.

Depending on the circumstances when the cavities of an acoustic element are completely or partially filled with such material, the absorption of the sound is much better.

In another preferred embodiment according to the invention, said first and/or second cavities are completely or partially filled with foamed clay, glass and pearlite.

In a first method for manufacturing acoustic construction elements according to the invention, the elements are manufactured in one step process.

Such method is used where the sound isolating material has a bake curve corresponding to the material from which the acoustic construction elements are made.

A second method for manufacturing acoustic construction elements is to manufacture the elements in a two process step.

In a two process step, the sound isolating material, for example : polystyrene foam (such as isomo), glass wool,... is introduced in the cavities in a second process step. This method is of course also applicable for material

which has a bake curve corresponding to the material from which the acoustic construction elements are made.

Preferably, said construction element is made of ceramic material. In this way, ceramic construction elements can be used as regular building bricks. The construction element according to the invention can also be used as a traffic load carrying construction element.

The method for manufacturing acoustic construction elements is preferably by way of extrusion of the ceramic materials.

Further distinctive features and characteristics will be clarified in the following description of a specific embodiment of the invention as represented in the attached drawings. It should be noted that this embodiment is only given by way of example and implies no restriction in the general scope of the invention as that appears from the above description and from the claims at the end of this text.

In the attached drawings:

- figure 1 is a cross section of an acoustic construction element;
- figure 2 is a cross section of an acoustic construction element of which the cavities have an angular shape;
- figure 3 is a cross section of an acoustic construction element of which the cavities have an angular or pseudo-rectangular shape.

As shown in figure 1, the acoustic construction element is an acoustic brick (1) with a length of 324 cm., a height of 5 cm. and a width of 10 cm. The brick is manufactured by extrusion of ceramic material, more specific red-baking clay. The acoustic brick has a smooth surface. By using other clays or by addition of aggregates to the base material, the brick can obtain a different colour or even a sandy structure. The surface can also be rough. In function of the composition, characteristics as the absorption of water, the intensity of the pressure, etc can differ.

As shown in figures 1, 2 and 3, the acoustic brick (1) comprises at irregular distances, separate entries (2) of cavities (3), the cavities in general are designated by reference numerals 3. etc., which:

- have different depths, this difference is shown in figure 1, where one notices that cavity (3.11.a) is deeper than cavity (3.10.a);
- have different internal volumes and/or different shapes, there are cavities which have an angular shape (3.1.a, 3.2.a, 3.3.a, 3.4.a, 3.7.a) and cavities with an pseudo-rectangular shape (3.5.b, 3.6.b, 3.8.b, 3.9.b).
  The purpose behind this is to obtain a volume as large as possible after the entry of the cavity (3);
- have a substantially constant width over their entire depth;

- are completely or partially filled with sound insulating material, according to the figures 1,2 and 3, all the cavities in figure 1 are completely filled, in figure 2 and 3, are 3.1a, 3.2a, 3.3a 3.5b, 3.6b, 3.7a and 3.8b partially filled. The other cavities 3.4a and 3.9b are completely filled.

A possible sound insulating material is ceramic foam. Ceramic foam is a very porous material with a very low coefficient of heat conduction.

The brick has thus a two-fold function: for one, the ceramic mass takes care for the absorption of the sound - the ceramic mass is the combination of the brick and the sound absorbing material -, And for another, the cavities, partially or completely filled with sound insulating material, are dimensioned in such a way that through the way of internal reflection, the sound doesn't get the chance to be reflected into free space.

In this way, the depth, the shape and the internal volume of the cavities (3) and their position on the stone can be adapted in function of certain types of frequencies and/or the level of the sound that has to be adsorbed.

An other object of the invention is the method of manufacturing an acoustic construction element comprising sound insulating cavities.

A first method is to manufacture a brick in one process step. Hereby, the brick is extruded of ceramic material and is provided with a cavity (3).

After the drying of the formed stone, the sound insulting material is introduced through the entry (2) of the cavity (3). This combination (brick+sound insulating material) is brought into a heating device where during one process step baking as well as expansion of the sound insulating material happened.
Use of this method is only possible if the sound insulating material has a bake curve corresponding to the material from which the acoustic construction elements are made.

Another method for manufacturing a construction element according to the invention is to fabricate a brick in a two process step.
Hereby, the sound insulating materials, for example glass wool, foamed plastic (such as isomo),... are introduced in a second process step, after the drying and baking of the brick.

The acoustic construction element according to the invention can be used in every place where noise or noise pollution is an item, for instance in:

- laboratory
- hospitals
- industry
  - as an inside or outside wall of factories, offices,...
  - around compressors, motors, machines and computer rooms
- concert halls, theatres, disco's, exposition halls, cinema rooms, hotel and catering industry,...

- along motorways, highways, train sections. stations, airports,..
- as a partition wall in apartment buildings and office buildings: around elevator shafts, engine rooms,...
- municipal buildings: libraries, sport halls, cultural centres,
- school and universities
- agriculture and cattle breeding: pig farms, chicken coops,...

In certain applications, the cavities can also serve as a carrier of technical pipes for, for instance, electricity, computers, telephone, sanitary, heating, ...

The bricks or the panels can be mounted either horizontally, either vertically, or in a combination of the two, can be glued together or laid in bricks, or can function as a carrying or non-carrying part. For example, the bricks can be used as road blocks on which traffic can circulate. The disturbing frequencies that arise when car types roll over the road surface can be absorbed by using the acoustic bricks as horizontal carrying driving surfaces. The cavities that are present in the bricks could also function for draining the excess of water when it's raining.